METHOD AND SYSTEM FOR PREVENTING ERRONEOUS STARTING OF A VEHICLE HAVING A MANUAL TRANSMISSION

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BACKGROUND OF THE INVENTION

The present invention relates to a method and system for preventing erroneous starting of a vehicle having a manual transmission. More particularly, this invention relates to a simple and reliable safety system and method for preventing erroneous starting of a vehicle having a manual transmission when a remote starter is used.

When a remote starter is used for manual transmission vehicles, safety is a huge concern. If a remote starter starts the vehicle when it is in gear, it will lurch forward and can create costly damages or cause injuries to people. Some manufacturers do not offer remote starters for manual transmission vehicles and some offer them with safety devices and methods that prevent a driver from leaving a vehicle in gear.

Such devices and methods force a driver to put the vehicle in a neutral position but this can be circumvented or faulty sensor will start the vehicle in gear by a remote starter.

A safety device for a manual transmission vehicle, which is reliable and independent, has long been in need.

SUMMARY OF THE INVENTION

The present invention contrives to solve the disadvantages of the prior art.

An objective of the invention is to provide a safety system for a manual transmission vehicle that prevents erroneous moving of the vehicle.

Another objective of the invention is to provide a safety system for a manual transmission vehicle, which is not affected by malfunction of other devices of the vehicle.

Still another objective of the invention is to provide a safety system for a manual transmission vehicle, which can evaluate vehicle's specific conditions so that a lurch condition is clearly distinguished from normal driving conditions.

To achieve the above objectives, the present invention provides a safety system for a vehicle having an engine and a manual transmission. The system includes a motion transducer module detecting motion of the vehicle, and a controller module deciding erroneous starting of the vehicle and stopping the vehicle when erroneous starting is decided. The controller module receives motion data from

the motion transducer module. A baseline is set in the detected motion data. The controller module calculates number of baseline crossings that occur within a predetermined time frame in the motion data. The controller module decides erroneous starting based on the number of baseline crossings.

Preferably, the predetermined time frame is about 250 millisecond.

The vehicle may further include a remote starter that receives signal from a remote controller, and starts the engine of the vehicle. The controller module stops the remote starter from cranking the engine when erroneous starting is decided.

Preferably, the controller module adjusts the baseline so that the baseline incorporates specific characteristics of the vehicle. The controller module adjusts the baseline based on averaged motion data from the motion transducer module when the remote starter is inactive.

The controller module starts calculating the number of baseline crossings when the motion data shows a predefined variation from the baseline, which indicates that the vehicle is being started.

The motion transducer module includes an accelerometer, which senses acceleration in one-dimension, two-dimension or three-dimension.

The safety system may include a signal conditioning module that buffers and filters the motion data from the motion transducer module.

The present invention also provides a method for preventing erroneous starting of a vehicle having a manual transmission and an engine. The method includes the steps of detecting motion of the vehicle, deciding erroneous starting of the vehicle based on the detected motion data, and stopping the vehicle when erroneous starting has been decided. A baseline is set in the detected motion data, and erroneous starting is decided based on number of baseline crossings that occur within a predetermined time frame in the motion data.

The method may further includes a step of receiving signal from a remote controller and activating a remoter starter that starts the engine of the vehicle before the step of detecting motion of the vehicle.

Preferably, the method further includes a step of adjusting the baseline so that the baseline incorporates specific characteristics of the vehicle. The baseline is

adjusted based on averaged motion data when the remote starter is inactive.

In the step of deciding erroneous starting, the number of baseline crossings starts to be calculated when the motion data shows a predefined variation from the baseline, which indicates that the vehicle is being started.

The advantages of the present invention are: (1) the safety system of the present invention can reliably distinguish the lurch condition from normal driving conditions; (2) the safety system can be adjusted to fit the specific environment including the vehicle to which it is installed and installation process; (3) a user can customize the operation of the system; and (4) the safety system provides an additional safety to current remote starters in the market.

Although the present invention is briefly summarized, the fuller understanding of the invention can be obtained by the following drawings, detailed description and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects and advantages of the present invention will become better understood with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic diagram showing how a safety system of the present invention is used for a vehicle having a manual transmission;

FIG. 2 is a schematic diagram showing the safety system;

FIG. 3 is a flow diagram showing a safety method of the present invention;

FIG. 4 is a graph showing readings from a accelerometer;

FIG. 5 is a flow diagram showing a firmware for the safety system; and

FIG. 6 is a circuit diagram for the safety system.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a safety system **10** of the present invention, and a vehicle **12** in which the safety system **10** is installed. The vehicle **12** includes an engine **14**, a manual transmission **16**, a starter **18**, a vehicle control module **20** that controls the engine and other parts, a remote starter **22**, and a shift lever **24**.

FIG. 2 shows that the safety system **10** includes a motion transducer module **26**, which detects motion of the vehicle **12**, and a controller module **28**, which decides erroneous starting of the vehicle and stops the vehicle **12** when erroneous starting is decided.

The motion transducer module **26** is used to convert acceleration or motion of the vehicle **12** into an electrical signal. The controller module **28** receives motion data from the motion transducer module **26**. As shown in FIG. 4, a baseline **30** is set in the detected motion data. The controller module **28** calculates number of baseline crossings that occur within a predetermined time frame in the motion data. The controller module **28** decides erroneous starting based on the number of baseline crossings. The controller module **28** uses a microcontroller to evaluate the signal from the motion transducer module **34** and make a decision as to whether a lurch condition is present or not.

Preferably, the predetermined time frame is about 250 millisecond.

The remote starter **22** receives signal from a remote controller **32**, and starts the engine **14** of the vehicle **12**. The controller module **28** stops the remote starter **22** from cranking the engine **14** when erroneous starting is decided. That is, the safety system **10** will shut down the remote starter **22** from cranking (starting the vehicle **12**) when it detects the movement of the vehicle **12** during the cranking period (starting the car) and remote started period (engine on period).

Due to the vehicle to vehicle variations and the inconsistencies in the installation process it may be required that the safety system **10** learn the characteristics of the vehicle **12** in which it is installed.

Preferably, the controller module **28** adjusts the baseline **30** so that the baseline **30** incorporates specific characteristics of the vehicle **12**. The controller module **28** adjusts the baseline **30** based on averaged motion data from the motion transducer module **26** when the remote starter **22** is inactive.

The controller module **28** starts calculating the number of baseline crossings when the motion data shows a predefined variation from the baseline **30**, which indicates that the vehicle **12** is being started.

The motion transducer module **26** comprises an accelerometer **34**. It would likely be possible to use other sensors such as tilt or motion sensors instead of the accelerometer **34**. In the embodiment, 2 axis (two dimension) accelerometer is used. Also, three-dimension accelerometer would work as well and possibly even a single axis device.

The safety system **10** may further include a signal conditioning module **36** that buffers and filters the motion data from the motion transducer module **26**. Analog circuitry is used to buffer and filter the signal from the motion

transducer module **26** before it is input to the controller module **20**.

The system **10** is capable of identifying the lurch condition. If a lurch is detected, the system **10** will signal the control module **20** to immediately turn off the vehicle **12**. The key is to use the motion transducer module **26** capable of converting any movement of the vehicle **12** into an electrically measurable property. The output of the motion transducer module **26**, that is, the motion data, is processed using analog circuitry and digital signal processing by the signal conditioning module **36**. The signal processing is required to differentiate the lurch from normal and acceptable conditions. When the vehicle **12** is first started, there is motion due to the starter **18** and vibrations once the vehicle **12** is running. The motion transducer module's **26** output can also be affected by the inclination of the vehicle **12** when it is parked on a hill. During installation of the safety system **10**, it is difficult to ensure that the equipment is installed in a consistent orientation to the vehicle **12**. Variations in the orientation will affect the response of the motion transducer module **26** to the vehicle's **12** motion. All these variations need to be dealt with through analog and digital signal processing.

The safety system **10** also includes a power supply **38** and an interface **40** to the remote starter **22** or other part of the vehicle **12**. The power supply **38** is used to supply power to the rest of the safety system **10**. It is based around a voltage regulator, **U1** (refer to FIG. 6). The input power is obtained from the vehicle **12**.

FIG. 5 shows a flow diagram of a firmware that is installed in the controller module **20**.

When the vehicle **12** starts under safe conditions there is movement but it has different characteristics than a lurch condition. The firmware must be able to reliably differentiate between the two conditions. The firmware looks at the number of baseline crossings that occur within the set time frame. The baseline can be affected by temperature and the inclination of the vehicle and these variations need to be compensated for.

There is an input to the safety system **10** from the remote starter **22**, GWR, that indicates that the remote starter **22** is attempting to start the vehicle **12** or that the vehicle **12** is running. GWR represents "Ground output While Run" - This is a (-) output from the remote starter **22** which turns on while the remote starter **22** is engaged. This output is used to turn on bypass units or other devices that may need to be turned on while the remote starter **22** is engaged.

While GWR is inactive, the safety system **10** continually takes samples of the accelerometer **34** output and averages them. This takes care of changes of value due to temperature, vehicle position, and any sensor variations. When the input goes into an active state, the present average values of the accelerometer **34** readings are used as the baseline **30**.

When the GWR goes, active the device watches for a reading from the accelerometer that is a certain variation from the baseline. This variation is used to indicate the beginning of an attempted start. It then starts the 250 millisecond phase during which the number of times the accelerometer reading crosses the baseline is recorded. Based upon the number of crossings a decision is made if the start condition was a lurch or a safe start condition.

Essentially this is a method of determining the dominant frequency of a vibrational movement. This frequency is different for a safe start and a lurch condition.

This analysis could also be done with a Fast Fourier Transform (FFT), or similar method. FIG. 4 gives a visual description of the readings from the accelerometer.

FIG. 6 shows a circuit that implements the safety system **10**. In the safety system **10**, the user can set two jumpers to vary the operating parameters of the safety system **10**.

In normal driving conditions, the output of the safety system **10** is pulled low. When a lurch condition is detected the output is pulled high. This provides a fail-safe operation.

FIG. 3 shows a method for preventing erroneous starting of the vehicle **12**. The method includes step **S02** of detecting motion of the vehicle **12**, step **S03** of deciding erroneous starting of the vehicle based on the detected motion data, and step **S04** of stopping the vehicle **12** when erroneous starting has been decided. The baseline **30** is set in the detected motion data, and erroneous starting is decided based on number of baseline crossings that occur within the predetermined time frame in the motion data.

The method may further include step **S01** of receiving signal from the remote controller **32** and activating a remoter starter **22** that starts the engine **14** of the vehicle **12** before step **S02**.

Preferably, the method further includes step **S05** of adjusting the baseline **30** so that the baseline **30** incorporates specific characteristics of the vehicle **12**. The baseline **30** is adjusted based on averaged motion data when the remote starter is inactive.

In step **S03**, the number of baseline crossings starts to be calculated when the motion data shows a predefined

variation from the baseline **30**, which indicates that the vehicle **12** is being started.

While the invention has been shown and described with reference to different embodiments thereof, it will be appreciated by those skilled in the art that variations in form, detail, compositions and operation may be made without departing from the spirit and scope of the invention as defined by the accompanying claims.